

TRANSMITTAL LETTER TO THE UNITED STATES

DESIGNATED/ELECTED OFFICE (DO/EO/US)

CONCERNING A FILING UNDER 35 U.S.C. 371

112 156

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09787988

INTERNATIONAL APPLICATION NO.

PCT/DE99/00078

INTERNATIONAL FILING DATE

15 January 1999

PRIORITY DATE CLAIMED

22 September 1998

TITLE OF INVENTION

A METHOD FOR RECEIVING OR TRANSMITTING MESSAGES

APPLICANT(S) FOR DO/EO/US

Juergen Michel et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/PEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Submission of Drawings - Figs. 1-2 on two sheets

| | | |
|--|---|--|
| U.S. APPLICATION NO. (IF KNOWN) 09/787988 | INTERNATIONAL APPLICATION NO. PCT/DE99/00078 | ATTORNEY'S DOCKET NUMBER 112740-156 |
|--|---|--|

21. The following fees are submitted:

| BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1,000.00 <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 | CALCULATIONS PTO USE ONLY | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|-----------------------|--------------|--|----|--------------|-----------|---|-----------|---------------|--------------------|---------|---|-----------|---------------|---|--|--|--|--|------------------------------------|--|--|--|-------------------|--|
| ENTER APPROPRIATE BASIC FEE AMOUNT = | \$860.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)). | <input type="checkbox"/> 20 <input type="checkbox"/> 30 \$0.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%;">CLAIMS</th> <th style="width: 20%;">NUMBER FILED</th> <th style="width: 20%;">NUMBER EXTRA</th> <th style="width: 20%;">RATE</th> <th style="width: 20%;"></th> </tr> <tr> <td>Total claims</td> <td>12 - 20 =</td> <td>0</td> <td>x \$18.00</td> <td style="text-align: center;">\$0.00</td> </tr> <tr> <td>Independent claims</td> <td>3 - 3 =</td> <td>0</td> <td>x \$80.00</td> <td style="text-align: center;">\$0.00</td> </tr> <tr> <td colspan="4">Multiple Dependent Claims (check if applicable) .</td> <td style="text-align: center;"><input type="checkbox"/> \$0.00</td> </tr> <tr> <td colspan="4" style="text-align: right;">TOTAL OF ABOVE CALCULATIONS</td> <td style="text-align: center;">= \$860.00</td> </tr> </table> | CLAIMS | NUMBER FILED | NUMBER EXTRA | RATE | | Total claims | 12 - 20 = | 0 | x \$18.00 | \$0.00 | Independent claims | 3 - 3 = | 0 | x \$80.00 | \$0.00 | Multiple Dependent Claims (check if applicable) . | | | | <input type="checkbox"/> \$0.00 | TOTAL OF ABOVE CALCULATIONS | | | | = \$860.00 | |
| CLAIMS | NUMBER FILED | NUMBER EXTRA | RATE | | | | | | | | | | | | | | | | | | | | | | | |
| Total claims | 12 - 20 = | 0 | x \$18.00 | \$0.00 | | | | | | | | | | | | | | | | | | | | | | |
| Independent claims | 3 - 3 = | 0 | x \$80.00 | \$0.00 | | | | | | | | | | | | | | | | | | | | | | |
| Multiple Dependent Claims (check if applicable) . | | | | <input type="checkbox"/> \$0.00 | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL OF ABOVE CALCULATIONS | | | | = \$860.00 | | | | | | | | | | | | | | | | | | | | | | |
| Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable) . | <input type="checkbox"/> \$0.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUBTOTAL = \$860.00 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)). | <input type="checkbox"/> 20 <input type="checkbox"/> 30 + \$0.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL NATIONAL FEE = \$860.00 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). | <input type="checkbox"/> \$0.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL FEES ENCLOSED = \$860.00 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">Amount to be refunded</td> <td style="width: 20%; text-align: center;">\$</td> </tr> <tr> <td>charged</td> <td style="text-align: center;">\$</td> </tr> </table> | Amount to be refunded | \$ | charged | \$ | | | | | | | | | | | | | | | | | | | | | |
| Amount to be refunded | \$ | | | | | | | | | | | | | | | | | | | | | | | | | |
| charged | \$ | | | | | | | | | | | | | | | | | | | | | | | | | |

☒ A check in the amount of **\$860.00** to cover the above fees is enclosed.
☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees.
 A duplicate copy of this sheet is enclosed.
☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

William E. Vaughan
 Bell, Boyd & Lloyd LLC
 P.O. Box 1135
 Chicago, IL 60690-1135

SIGNATURE
 William E. Vaughan
 NAME
 39,056
 REGISTRATION NUMBER
 March 22, 2001
 DATE

BOX PCT
IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANTS: Juergen Michel et al. DOCKET NO: 112740-156
SERIAL NO: GROUP ART UNIT:
EXAMINER:
INTERNATIONAL APPLICATION NO: PCT/DE99/00078
INTERNATIONAL FILING DATE: 15 January 1999
INVENTION: A METHOD FOR RECEIVING OR TRANSMITTING
MESSAGES

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry
into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C.
§371 as follows:

In The Specification:

On page 1, cancel lines 1-3 and substitute the following therefor:

--SPECIFICATION

TITLE

A METHOD FOR RECEIVING OR TRANSMITTING MESSAGES

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for receiving or transmitting
messages wherein different spreading codes are correlated for spread-spectrum
signals in a simplified manner and orthogonality of the spreading codes can be
maintained.--

On page 1, before line 5, insert the following left-hand justified heading:

--Description of the Prior Art--

On page 1, line 20, cancel the “,” and substitute therefor a --;--.

On page 1, line 20, insert a --,-- after “e.g.”.

5 On page 2, line 7, insert --, therefore,-- after “invention”.

On page 2, line 8, cancel “technical teaching by means of” and substitute therefor --method by--.

On page 2, cancel lines 11-12.

On page 2, before line 13, insert the following centered heading:

10 **--SUMMARY OF THE INVENTION--**

On page 2, line 13, cancel “In this method,” and substitute therefor --
Accordingly, the method of the present invention uses--.

On page 2, line 13, insert a --,-- after “code”.

On page 2, line 15, cancel “is used” and substitute therefor a --,--.

15 On page 2, line 17, cancel “comprises” and substitute therefor --includes--.

On page 2, line 22, insert --present-- before “invention”.

On page 2, line 23, cancel “by means of” and substitute therefor --via--.

On page 2, line 29, cancel the “,” and substitute therefor a --;--.

On page 2, line 29, insert a --,-- after “example”.

20 On page 2, line 34, cancel “is”.

On page 2, line 34, insert --is-- after “here”.

On page 2, line 39, insert a --,-- after “If”.

On page 2, line 39, insert a --,-- after “process”.

On page 3, line 2, cancel “differs” and substitute therefor --differ--.

25 On page 3, cancel lines 4-6.

On page 3, line 7, insert --present-- before “invention”.

On page 3, line 8, cancel “adaptive”.

On page 3, line 11, insert --can be-- after “and”.

On page 3, line 13, insert --present-- before “invention”.

On page 3, line 14, cancel "by means of" and substitute therefor --via--.

On page 3, line 18, insert --present-- before "invention".

On page 3, cancel lines 21-24 and substitute the following therefor:

--Additional features and advantages of the present invention are described

- 5 in, and will be apparent from, the following Detailed Description of the Preferred Embodiments and the Drawings.

DESCRIPTION OF THE DRAWINGS--.

On page 3, line 28, cancel the "." and substitute therefor --; and--.

On page 3, line 30, cancel "means of".

- 10 On page 3, before line 33, insert the following centered heading:

--DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

On page 3, line 37, cancel ", for example,".

On page 3, line 38, insert --, for example,-- after the ",".

On page 4, line 9, cancel the "," and substitute therefor a --;--.

- 15 On page 4, line 9, insert a --,-- after "i.e.".

On page 4, line 31, cancel "by means of" and substitute therefor --via--.

On page 4, line 36, cancel "means of".

On page 5, line 1, cancel "to the expert".

On page 5, line 3, cancel "the" and substitute therefor --an--.

- 20 On page 5, line 3, insert --in this field-- after "expert".

On page 5, line 4, cancel "present".

On page 5, line 5, insert --present-- before "invention".

On page 5, line 8, cancel "can" and substitute therefor a --,--.

On page 5, line 8, insert a --,-- after "thus".

- 25 On page 5, line 8, insert --can-- after "also".

On page 5, line 15, cancel "can".

On page 5, line 15, insert --can-- after "also".

On page 5, line 20, cancel the "-".

On page 5, line 21, cancel the "-".

- On page 5, line 29, cancel "advantageously".
- On page 5, line 34, cancel "figure" and substitute therefor --Figure--.
- On page 6, line 6, cancel "can".
- On page 6, line 6, insert --can-- after "also".
- 5 On page 6, line 9, insert a --,-- after the ")".
- On page 6, line 10, cancel "which" and substitute therefor --These--.
- On page 6, line 16, cancel "this" and substitute therefor --the present--.
- On page 6, line 20, cancel "said" and substitute therefor --stated--.
- On page 6, line 21, cancel "naturally,".
- 10 On page 6, line 24, cancel "; instead" and substitute therefor --. Instead--.
- On page 6, line 24, cancel "sufficiently" and substitute therefor --
substantially--.
- On page 6, line 26, cancel "also".
- On page 6, line 37, cancel "means of".
- 15 On page 7, line 7, cancel "being" and substitute therefor --is--.
- On page 7, line 18, cancel "can".
- On page 7, line 18, insert --can-- after "also".
- On page 7, line 27, cancel the "-" and substitute therefor a --,--.
- On page 7, line 27, cancel "figure" and substitute therefor --Figure--.
- 20 On page 8, line 10, insert --of the present invention-- after "method".
- On page 8, line 12, cancel "figure" and substitute therefor --Figure--.
- On page 8, line 15, cancel "can".
- On page 8, line 15, insert --can-- after "also".
- On page 8, line 16, cancel "figure" and substitute therefor --Figure--.
- 25 On page 9, line 2, insert --present-- before "invention".
- On page 9, after line 8, insert the following paragraph:
- Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be

made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.--

On page 13 (last page), cancel lines 1-3 and substitute the following centered heading therefor:

5 --**ABSTRACT OF THE DISCLOSURE**--.

On page 13., line 5, cancel "The" and substitute therefor --A method for receiving or transmitting messages wherein the--.

On page 13, line 9, cancel the "." and substitute therefor --and--.

On page 13, line 10, cancel "To" and substitute therefor --to--.

10 On page 13, line 11, cancel "must be" and substitute therefor --are--.

In the Claims:

On page 10, cancel line 1, and substitute the following left-hand justified heading therefor:

--We Claim As Our Invention:--.

15 Please cancel claims 1-12, without prejudice, and substitute the following claims therefor:

13. A method for receiving messages in a digital transmission, the method comprising the steps of:

20 receiving a spread-spectrum signal keyed with a first spreading code at a receiver;

 using a second spreading code which is shorter than the first spreading code to receive the spread-spectrum signal; and

 correlating the spread-spectrum signal with the second spreading code at the receiver.

25 14. A method for receiving messages in a digital transmission as claimed in claim 13, the method further comprising the step of:

 defining the second spreading code to be a code segment of the first spreading code.

15. A method for receiving messages in a digital transmission as claimed in claim 13, the method further comprising the step of:
selecting the second spreading code to be as short as possible to still enable
5 messages to be received with sufficient quality and reliability.

16. A method for receiving messages in a digital transmission as claimed in claim 15, the method further comprising the steps of:
continuously assessing the quality of the received messages; and
10 continuously adapting a length of the second spreading code to an instantaneous quality of reception such that an adequate quality of reception is achieved.

17. A method for receiving messages in a digital transmission as claimed in claim 15, the method further comprising the step of:
15 determining the quality of reception with the aid of redundant codes which were used for channel coding of the messages.

18. A method for receiving messages in a digital transmission as claimed in claim 15, the method further comprising the step of:
20 improving the quality of reception with the aid of error correction codes which were used for channel coding of the messages.

19. A method for receiving messages in a digital transmission as claimed in claim 13, wherein individual facilities of the receiver are at least one of
25 intermittently turned off and operated at a lower clock frequency due to the second spreading code being shorter than the first spreading code.

20. A method for receiving messages in a digital transmission as claimed in claim 19, wherein the intermittent turning off of the individual facilities of the receiver is controlled by a control device such that power consumption of the receiver is as low as possible with a predetermined quality of reception.

5

21. A method for receiving messages in a digital transmission as claimed in claim 20, wherein shortened spreading codes are selected for two successive symbols of a message to be detected such that the individual facilities of the receiver can be turned off over coherent periods of time which are as long as possible.

10

22. A method for receiving messages in a digital transmission as claimed in claim 13, wherein the second spreading code is extended to form a third spreading code which is also shorter than the first spreading code if the quality of reception is not adequate when the second spreading code is used.

15

23. A method for transmitting messages in a digital transmission to a plurality of receivers, the method comprising the steps of:

spreading a spectrum of message signals for the plurality of receivers via a plurality of first spreading codes which are respectively different for each of the plurality of receivers;

20

spreading a spectrum of message signals which are intended for a group of receivers via a further first spreading code which is common to all of the receivers of the group;

25

selecting the plurality of first spreading codes such that a plurality of second spreading codes respectively associated with the plurality of first spreading codes have as low as possible a correlation with the further first spreading code used for the group of receivers; and

defining the plurality of second spreading codes to be shorter than the plurality of first spreading codes.

24. A method for transmitting messages in a digital transmission to
5 a plurality of receivers wherein a spreading code, which has an essentially non-
vanishing cross-correlation with a spreading code of a paging channel, is used only
if no other spreading code is available.

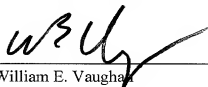
REMARKS

- The present amendment makes editorial changes and corrects typographical
10 errors in the specification in order to conform the specification to the requirements
of the United States Patent practice. No new matter is added thereby. Original
claims 1-12 have been canceled in favor of new claims 13-24. Claims 13-24 have
been presented solely because the revisions by bracketing and underlining which
would have been necessary in claims 1-12 in order to present those claims in
15 accordance with preferred United States Patent practice would have been too
extensive, and thus would have been too burdensome. The amendment is intended
for clarification purposes only and not for substantial reasons related to patentability
pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-
12 does not constitute an intent on the part of the Applicants to surrender any of the
20 subject matter of claims 1-12.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

25



(Reg. No. 39,056)

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Attorneys for Applicants

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8. The method as claimed in claim 7, in which the intermittent turn-off of individual facilities of a receiving unit is controlled by a control device provided for this purpose, in such a manner that the power consumption of the receiving unit is as low as possible with a predetermined quality of reception.

9. The method as claimed in claim 8, in which shortened spreading codes are selected for two successive symbols of a message to be detected, in such a manner that individual facilities of a receiving unit can be turned off over coherent periods of time which are as long as possible.

10. The method as claimed in one of the preceding claims, in which the second or a previous spreading code is extended to form a third or further spreading code which is also shorter than the first spreading code if the quality of reception is not adequate when the second or previous spreading code is used.

11. The method for transmitting messages to a multiplicity of receivers in which

a) the spectrum of message signals for individual receivers is spread by means of first spreading codes which are individually different for each receiver,

b) the spectrum of message signals which are intended for a group of receivers is spread by means of a first spreading code which is common to all receivers of this group, and in which

c) the individually different first spreading codes are selected in such a manner that the second spreading codes belonging to these individually first spreading codes have as low as possible or ideally a vanishing correlation with a spreading code which is used for this group of receivers,

d) the second spreading codes are shorter than the first spreading codes.

12. The method for transmitting messages to a multiplicity of receivers in which a spreading code which has an essentially non-vanishing cross correlation with the spreading code of a paging channel, is used only if no other spreading code is available.

Description

Method for receiving or transmitting messages

- 5 In a digital transmission of messages between a transmitter and a receiver, so-called spreading codes are frequently used. If a transmit signal is keyed with such a spreading code, the spectral bandwidth of the transmit signal is increased. In general, spreading
- 10 codes are used with clock pulses with time constants (chips, TC) which are much smaller than the pulse widths (T) of the digital message signal. One pulse or one symbol of the digital message signal is then distributed over a multiplicity N of chips of the
- 15 spreading code as a result of which the bandwidth of the message signal is correspondingly multiplied.

- Important examples of such spread-spectrum transmission methods are the so-called code division multiple access (CDMA) methods which play an ever more
- 20 important role, e.g. in the field of mobile telephony or of wireless data transmission. In these methods, the spread-spectrum signal is correlated with a matching spreading code in the receiver. Since different spreading codes which are not equivalent virtually have
- 25 a vanishingly small correlation with one another, this method enables exactly one useful signal to be detected in a multiplicity of useful signals contained in the spread-spectrum signal, all other useful signals which have been keyed with other spreading codes in a
- 30 transmitter being effectively suppressed in the receiver. A necessary prerequisite for this is generally considered to be that the receiver uses for the correlation the same spreading code as was used for keying (spreading) the useful signal intended for it.

- 35 Devices for carrying out such methods are generally of a very complex construction. Because a large and

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continually rising number of useful channels is needed, the spreading codes used become quite long and the corresponding clock times become shorter and shorter. This requires, for example, correlators of
5 corresponding complexity and with a correspondingly high clock rate.

It is an object of the present invention to specify a technical teaching by means of which the complexity of the correlation and generally of the
10 reception of spread-spectrum signals can be reduced. This object is achieved by a method according to one of the patent claims.

In this method, a second spreading code which is shorter than the first spreading code used for
15 keying the message signal in the transmitter is used for receiving the transmitted messages. If the first spreading code comprises N chips, the second spreading sequence manages with M chips, M being smaller than N. This simplifies the process of correlation of the
20 spread-spectrum signal with the second spreading code in the receiver. In the transmission of messages, the invention provides for the use of suitable spreading codes by means of which the orthogonality of the spreading codes of different channels can be
25 maintained.

It is true that systems are known in which a shorter spreading code is used in the receiver than in the transmitter for synchronizing the receiver with the transmitter, for example from US patent specification
30 5,673,260 (Method and System for CDMA Mobile Communication) of 30 September 1997. During the synchronization, however, very long synchronization data sequences are used which are known exactly to the receiver. Thus, the problem is here not the detection
35 of the data (messages) but the determination of the matching time delay between transmitter and receiver with the aid of known synchronization data. The present invention, in contrast, is used for the detection of data unknown to the receiver. If during this process

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- 2a -

shortened or shorter spreading codes are used in the receiver, this procedure

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and the associated problems to be solved fundamentally differs from the synchronization with shortened spreading codes.

Advantageous further developments of the invention are the subject matter of subordinate patent claims.

A preferred embodiment of the invention provides an adaptive adaptation of the spreading code length to the prevailing conditions of reception in each case. The quality of reception can be determined with the aid of redundant codes and improved, if necessary. Using suitable spreading codes in accordance with corresponding embodiments of the invention allows energy to be saved by means of intermittent turn-off or slower clocking of certain hardware units. At the transmitting end, the spreading codes can be selected, according to corresponding developments of the invention, in such a manner that an orthogonality of the short spreading sequences (which is sufficient in practice) is ensured.

In the text which follows, the invention will be explained in greater detail with reference to preferred exemplary embodiments and with the aid of the figures.

Figure 1 shows a diagrammatic representation of a preferred choice of short spreading codes which provides for an especially energy-saving operation of the receiving equipment.

Figure 2 shows a diagrammatic representation of a preferred selection of spreading codes by means of which the orthogonality of the spreading codes of different channels can be ensured.

In a transmission system designed in accordance with the principle of the spread-spectrum technique, the data symbols are transmitted via the transmission channel as explained in the text which follows. The transmit signal, existing, for example, of rectangular pulses with a period T , is keyed by a fast first

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- 3a -

spreading code of length $T=N*TC$. TC is here the chip
period of the

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spreading code. It is much smaller than T so that the signal becomes a broadband signal. Ideally, a white broadband signal is produced which is transmitted via the multipath channel with signal delays (t_k) and is detected in the receiver.

For the access of a number of users, mutually orthogonal spreading codes are used. For each useful channel, a separate spreading code is used which is orthogonal to the other spreading codes, i.e. the correlation of which with the other spreading codes vanishes (at least in practice). For this reason, all useful channels can be transmitted simultaneously and reach the receiver via a single broad frequency band.

To detect the transmit signal, the received signal is correlated in the receiver with the same spreading code which, however, is delayed by $t_k \in \{t_k\}$. This operations is also called despreading. The individual subscribers are selected with knowledge of the specific orthogonal spreading code. In addition, the paths having delays $t_k \neq t_K$ are suppressed since a time-shifted spreading code generally correlates (significantly) neither with other spreading codes nor with itself. Interrupting this in a different way, the receiver represents a filter which is signal-adapted to the respective useful channel and to the transmitter. Due to the correlation, unambiguous identification of the transmitter succeeds even in the case of a low signal/noise ratio.

Detection takes place as soon as a data bit has been received. It can be supported by powerful methods such as deinterleaving or channel decoding by means of viterbi algorithm. In this process, the redundancy of a code used for channel coding, which possibly also allows error correction, is used in the way of a step-by-step statistical estimation of the data bits, for example by means of a maximum a posteriori probability (MAP) method of estimation, for estimating and/or improving the quality of reception.

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Such methods are known to the expert, in principle. Their use in conjunction with the present invention does not provide any problems to the expert after he has read the present description of the invention.

If these methods are powerful enough or if the signal/noise ratio is large enough, the useful information can thus also be reconstructed (detected) if the correlation is not performed with the user-specific first spreading code of length $N \cdot TC$ matching in each case, which was also used in the transmitter. This is the fundamental idea on which the present invention is based. Instead, namely a shorter or shortened second spreading code of length $M \cdot TC$, with $M < N$, can also be used and instead of N chips, only M chips now need to be included in the signal processing.

As a result, a corresponding saving in hardware resources and energy is possible. This is because, with a suitable choice of a shortened or shorter spreading code which can be, for example, an - equidistantly or non-equidistantly - subsampled subcode of the spreading code used in the transmitter, systems having correspondingly lower clock rates or less powerful and more energy-saving processors can be used. If, on the other hand, shortened spreading codes are used which are contiguous segments of the spreading codes used in a transmitter, hardware units can be intermittently turned off and energy can thus be saved. This is particularly advantageously possible if shortened spreading codes for two successive symbols of a message to be detected are selected in such a manner that a turn-off of individual facilities of a receiving unit is possible over coherent periods of time which are as long as possible. As shown in figure 1, this can be implemented most simply by using a pair of shortened spreading codes, the first spreading code in time (KSF1) of which corresponds to the end of the corresponding unshortened spreading code (SF1) and the second spreading code in time (KSF2) of which corresponds

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to the corresponding unshortened spreading code (SF2).

5 Apart from shortened spreading codes in the actual sense of the word, which are genuine code segments, e.g. (a1, a4, a6, a7, a10, a11, a34, ...) of an unshortened spreading code, e.g. (a1, a2, a3, a4, a5, a6, a7, ...), other short spreading codes can also be used which can be considered to be code segments, e.g. (b1, b3, b5, b7, b9, ...) of another unshortened spreading code, e.g. (b1, b2, b3, b4, b5, b6, ...) 10 which, however, must have a sufficiently large cross correlation with one another, essentially proportional to (a1+b1, a2+b2, a3+b3, a4+b4, ...) so that the desired message channel can be detected with an adequate signal/noise ratio and other message channels 15 can be sufficiently suppressed. If in the context of the description of this invention mention is made of a shortened spreading code, so that the diction does not become too obscure, such more general spreading codes, better called shorter or short spreading codes, are also meant if the opposite is not said expressly. In 20 general, naturally, spreading codes similarly do not need to correspond to other spreading codes in the strict sense of the word in order to provide for a useful correlation; instead, a sufficiently high cross correlation is sufficient in most cases. When reading 25 this description, this also must be always considered if, for reasons of easier legibility in this description, only a (possibly only partial) correspondence of two spreading codes is simply mentioned in places. 30

After a bit or symbol of length $N \cdot TC$ transmitted with the aid of the spread-spectrum technique has been received, the despreading is started. With an adequate signal/noise ratio, the 35 transmitted symbol and the transmitted useful data can be generally completely reconstructed from this by means of correlation with the shortened specific spreading code of length

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M*TC. This is facilitated by utilization of the redundancy implemented in the channel coding. This results in a saving because not all transmitted chips need to be received and processed.

- 5 If, contrary to expectation, the reconstruction of the useful data is not possible, for example because of the quality of reception being too poor, the data must be made more precise by recorrelation with a spreading code which, if necessary, is longer. For this
10 purpose, more chips must be included in the correlation. Results of previous passes can be utilized. The basis for a decision for the state of the bit transmitted in each case can be the assessment of the signal/noise ratio or of the results of the
15 statistical estimation in the channel decoding. Having knowledge of the quality of transmission, an estimation of the minimum length of the shortened spreading code can also be made in dependence on the required reliability.
- 20 Using shorter spreading codes reduces the number of mutually orthogonal spreading codes. It is, therefore, advantageous to appropriately predetermine the mode and the order of assignment of the spreading codes to the users or, respectively, to the logical
25 channels or, respectively, not to use certain spreading codes within a radio cell. For example, it could be provided - as shown in figure 2, that the spreading code, the first half of which corresponds to the spreading code of the paging channel, is not used in
30 the system or is used only as the last one.

- This principle can be applied, in particular, to the so-called paging mode and the so-called broadcast channel (BCCH). A signal is transmitted there to a number of mobile stations which are located in a
35 radio cell. To ensure that this signal can be received by all mobile stations, it must be transmitted with a relatively high power. Most of the mobile stations are located in an advantageous

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position in which the quality of reception is good enough, and can use the method of correlation using shorter spreading codes described here without missing the message. The associated power saving is of particular importance in paging mode since it contributes directly and particularly noticeably to extending the stand-by time.

Analog/digital converters and correlators are particularly suitable for intermittent turn-off. This variant of the method is particularly advantageous in connection with the choice of spreading codes shown in figure 1. Subsampled code segments are particularly suitable for the variant of clocking with a lower clock frequency. This description shows the expert that both measures can also be used in combination.

As shown diagrammatically in figure 1, the first spreading codes SF1 and SF2 are used for keying (spreading) the message symbols (data, bits, code words or similar) NS1, NS2, NS3, NS4 following one another in time in the transmitter. Using then the short or shortened spreading codes KSF1 and KSF2, which are placed in time in such a manner that the control signal CS only needs to be switched on at times t1 and t3 and switched off at times t2 and t4 for controlling the hardware facilities to be turned on and off, in the receiver. If the short spreading codes KSF1 and KSF2 are placed so that they are not contiguous in time, the control signal would have to be keyed more quickly which would cause a greater energy consumption.

Figure 2 illustrates the relationships in selecting suitable spreading codes. These can be represented systematically in a so-called code tree which, with increasing length of the spreading codes, provides an exponentially growing number of orthogonal spreading codes. Since other types or systems of spreading codes which, lastly, are essentially equivalent, are known to the expert, only this

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type of spreading codes is dealt with here. However,
the invention can be carried out just as well using
other types of spreading codes. To prevent a loss of
orthogonality due to the use of shorter or shortened
5 spreading codes, it is useful to reserve the spreading
codes in area r1 for the paging channel and only to use
the spreading codes from area r2 for spreading
individual user channels.

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Patent claims

1. A method for receiving messages in which a spread-spectrum signal using a first spreading code is correlated, for the purpose of detecting the messages, with a second spreading code which is shorter than the first spreading code.
2. The method as claimed in claim 1, in which the shortened second spreading code is a code segment of the first spreading code.
3. The method as claimed in one of the preceding claims, in which the second spreading code is selected to be as short as possible but just long enough to enable messages to be received with sufficient quality or reliability.
4. The method as claimed in claim 3, in which the quality of the received messages is continuously assessed and in which the length of the second spreading code used is continuously adapted to the instantaneous quality of reception in such a manner that an adequate quality of reception is achieved.
5. The method as claimed in one of claims 3 or 4, in which the quality of reception is determined with the aid of redundant codes which were used for the channel coding of the messages.
6. The method as claimed in one of claims 3, 4 or 5, in which the quality of reception is improved with the aid of error correction codes which were used for the channel coding of the messages.
7. The method as claimed in one of the preceding claims, in which individual facilities of a receiving unit such as, for example, analog/digital converters or correlators are intermittently turned off or are operated at a lower clock frequency because a second spreading code which is shorter than the first spreading code is used for the correlation.

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8. The method as claimed in claim 7, in which the intermittent turn-off of individual facilities of a receiving unit is controlled by a control device provided for this purpose, in such a manner that the power consumption of the receiving unit is as low as possible with a predetermined quality of reception.

9. The method as claimed in claim 8, in which shortened spreading codes are selected for two successive symbols of a message to be detected, in such a manner that individual facilities of a receiving unit can be turned off over coherent periods of time which are as long as possible.

10. The method as claimed in one of the preceding claims, in which the second or a previous spreading code is extended to form a third or further spreading code which is also shorter than the first spreading code if the quality of reception is not adequate when the second or previous spreading code is used.

11. A method for transmitting messages to a multiplicity of receivers in which

a) the spectrum of message signals for individual receivers is spread by means of first spreading codes which are individually different for each receiver,

b) the spectrum of message signals which are intended for a group of receivers is spread by means of a first spreading code which is common to all receivers of this group, and in which

c) the individually different first spreading codes are selected in such a manner that the second spreading codes belonging to these individually different first spreading codes have as low as possible or ideally a vanishing correlation with a spreading code which is used for this group of receivers.

12. The method for transmitting messages to a plurality of receivers in which a spreading code which has an essentially

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non-vanishing cross correlation with the spreading code of a paging channel, is not used or is used only if no other spreading code is available.

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Abstract

Method for receiving or transmitting messages

The use of shortened spreading codes, especially in the paging channel, for the purpose of correlation in the reception of CDMA signals, provides for power-saving measures such as, for example, the intermittent turn-off of A/D converters or correlators. To preserve the orthogonality of the spreading codes, the spreading codes used must be selected in such a manner that, if possible, they do not correlate with the paging channel spreading code.

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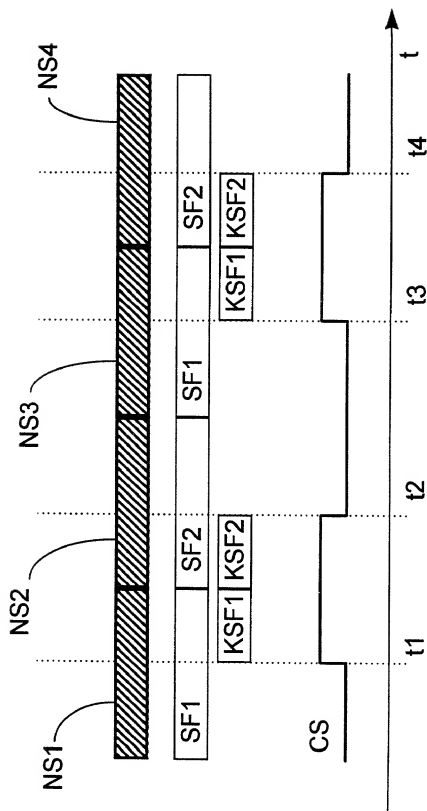


Fig. 1

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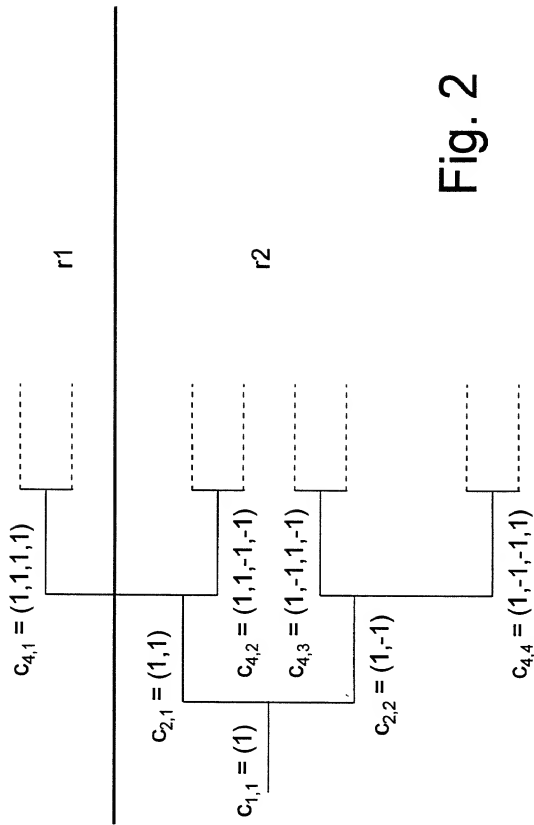


Fig. 2

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren zum Empfangen oder Senden von Nachrichten

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)

(check one)

☒ hier beigefügt ist.

☐ is attached hereto.

☐ am _____ als

☐ was filed on _____ as

PCT internationale Anmeldung

PCT international application

PCT Anmeldungsnummer _____

PCT Application No. _____

eingereicht wurde und am _____

and was amended on _____

abgeändert wurde (falls tatsächlich abgeändert).

(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obige ☐ Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

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German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

198 43 434.0 Germany

22. September 1998

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☒ ☐
Yes No
Ja Nein

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

(Number) (Country)
(Nummer) (Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐ ☐
Yes No
Ja Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date)
(Anmeldedatum)

(Status)
(patentiert, anhangig,
aufgegeben)

(Status)
(patented, pending,
abandoned)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date)
(Anmeldedatum)

(Status)
(patentiert, anhangig,
aufgeben)

(Status)
(patented, pending,
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Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

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German Language Declaration

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

And I hereby appoint

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(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

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